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NEO Characterization

CAPABILITIES OF PAST, PRESENT, AND FUTURE RADAR SYSTEMS FOR OBSERVATIONS OF NEAR-EARTH OBJECTS

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ABSTRACT

Ground-based radar systems have unique capabilities for physical and dynamical characterization of near-Earth asteroids and comets. With a planetary radar system, it is possible to measure a near-Earth object's radial velocity and distance with great accuracy (as fine as 1 cm/s and 100 m, respectively), through observations that take less than one hour. Radar astrometry from a single observation is usually sufficient to prevent a newly discovered object from becoming lost (due to growing uncertainties) after its first apparition and requiring later rediscovery. With fast and accurate determination of an NEO's orbital parameters and future trajectory, it is possible to rule out the vast majority of potential impacts, or otherwise to provide strong constraints on the time and location of a potential impact.

Radar is also very useful for physical characterization of NEOs, providing information on size, shape, surface properties, rotation state, and binarity, which aids planning of potential impact mitigation missions [1]. With radar, the observers control the transmitted signal and can change the properties of that signal (within the technical limitations of the system) to return the most useful information. The brightest radar targets can be resolved into sets of delay-Doppler images, revealing details almost as fine as in images from a spacecraft flyby, for much less cost.

Building upon the work of Naidu et al. 2016 [2], Roshi et al. 2021 [3], and Venditti et al. 2022 [4], we investigate how many near-Earth objects and potentially hazardous objects of different sizes could be detected with past, present, and potential future planetary radar systems. We consider radar transmissions from Arecibo Observatory, Goldstone Deep Space Communications Complex, Canberra Deep Space Communication Complex, and several radar facility concepts that have been proposed for the future.

References

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Comments:

Alternative session: If there is a session about radar or the Arecibo Observatory, please include this presentation there.
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